EDITORIAL ARTICLES.

ETHER OR CHLOROFORM—WHICH?

The important question as to the choice of an anæsthetic is by no means the simple affair which the partisans of one or the other claim it to be. Recent discussions on this subject in the British Medical Association, in the Academy of Medicine in New York, and in the County Medical Society in Brooklyn, together with many editorial and other contributions in various medical journals, have served to call attention to the various phases of this subject. Perhaps the most important of all the lessons to be derived from the facts which have been elicited is the entire unreliability of the statistical comparisons which have heretofore been relied upon to demonstrate the relative safety of the two great anæsthetics—ether and chloroform. It seems to have been quite clearly brought out that while as regards the immediate results from its administration, chloroform has rolled up a death rate far in excess of that produced by ether, still the latter is chargeable with many deaths from later complications determined by it, which are as yet an unknown quantity, though they are now becoming more appreciated.

Shock, defective and delayed reaction, heart-failure, pneumonia, pulmonary œdema, uræmia, nephritis, are terms which in many instances have explained deaths which were properly attributable to ether. The appreciation of these facts must lead to a more careful study of the whole subject of anæsthesia, and to greater attention to its technique by practitioners in general. As a contribution to this subject, Dr. A. B. Miles, of New Orleans, presented a memoir to the Orleans Parish Medical Society, June 27, 1887, which has been published in the August issue of the *New Orleans Medical and Surgical Journal*. In this memoir the relative merits and demerits of ether and chloroform, together with the conditions of the body which may influence their effects when administered for anæsthesia, are presented and discussed with great discrimination and clearness. With this preface we reproduce the greater part of it, which will be found to be worthy of careful study.

"Ether is the weaker anæsthetic, possessing the peculiar toxical quality in less degree than chloroform. In small quantity it is decidedly stimulating to the cerebrum and to the vital functions over which the medulla presides; and, in this action, it is more uniform than chloroform. Indeed, the vital reflexes are so uniformly stimulated by ether that the danger of its primary effect in healthy subjects is as small as possible under general anæsthesia. In those who take ether well, the stimulating effect on the heart's action and respiration may be observed throughout the anæsthesia. Ordinarily, even anæsthetic doses of ether do not depress these functions, but leave them to themselves, uninfluenced by the general anæsthetic action. Under etherization the heart's action and respiration are certainly less liable to the irregularities, which are not unfrequently observed in chloroform anæsthesia. In the latter stages of etherization, however, the vital reflexes may be depressed and powerfully, but gradually, so as to give warning of the approach of danger. Ether danger usually approaches by way of the lungs, and usually forewarns by the labored, stertorous, irregular breathing, and cyanosis, so as to allow the use of means to avert. Ether danger may, however, approach by the heart. In ten of forty well authenticated ether deaths the heart failed first. These deaths resemble chloroform deaths, but comparatively occur much less frequently. So the comparative safety of ether and its timely admonition of danger are its chief advantages. They are certainly points of great practical value in its favor.

Against the merits of ether stand in stronger relief to-day than ever before its disadvantages and its dangers. The advocates of ether, who use it excessively, especially those who yet believe in its absolute safety, are doing much to-day to demonstrate its dangers. Its inflammability in the presence of artificial light and the actual cauteries is one objection. The danger of igniting is modified by several conditions: the proximity of the light, its position, and whether exposed or not, the saturation of the surrounding air and the direction of the air currents. Ether may ignite at long distances (fifteen feet, it is said) if the currents set in the direction of an exposed light. But the dangers of inflammability may be modified, as above indicated, and much diminished. The exceedingly disagreeable odor and the irritating property of ether, when brought in contact with mucous surfaces, are serious disadvantages. It was this irritating property which refuted the claims of rectal etherization as a warrantable procedure in surgery, but not until it had brought sorrow on its advocates and a worse fate on some of its victims—diarrhœa, dysentery, hæmorrhage, collapse, death. The irritation of the respiratory mucous membrane usually causes coughing, strangling and violent resistance. It may cause catarrhal bronchitis and pneumonia. It may very seriously aggravate a pre-existing bronchial or parenchymatous inflammation.

The excessive secretion which ether causes to flow into the breathing passages, is also a disadvantage not to be lightly regarded. This may endanger life by suffocation, especially in cases of pulmonary disease, already attended with free secretion, as in the catarrhal affections of children and old people. It not unfrequently prolongs the asphyxia caused by the usual method of administering ether.

Patients are usually asphyxiated while being anæsthetized with ether. True the asphyxia favors the anæsthetic effect of ether, and therefore obviates the necessity of too greatly saturating the blood. But the asphyxia complicates and increases the danger of anæsthesia. The dangers of such a state are beyond question. They are not so immediate as those of chloroform, and, therefore, have been less apparent and less appreciated.

Asphyxia, as well as etherization, may be carried too far, and at times result disastrously. The respiratory nervous apparatus is exhausted and the heart fails secondarily. The tone of its own texture is destroyed by the supply of venous blood, and by impediment to the pulmonary circulation, its right ventricle becomes overdistended and powerless. So, etherization, as much from asphyxia due to the manner of administration, as from its anæsthetic affect, may depress the heart's action, as well as respiration. But the sequelæ of etherization are matters of more serious importance, to which attention is specially directed.

Aside from the danger of inflammatory diseases, caused by the irritating ether vapor, is the liability to pneumonia, as the result of obstructed pulmonary circulation.

Again, the asphyxia which goes along with etherization may increase the patient's depression and retard reaction. The deleterious blood changes in a patient who has undergone prolonged etherization, cannot be well suited to the healing of important wounds In the suffocating plan of administering ether the blood suffers not alone of the interruption to the interchange of gases, but as much of the rebreathing of excrementitious albuminoid products which physiologists tell us are so harmful.

The danger of nephritis, by the action of blood saturated with ether, first pointed out by Dr. Emmet, of New York, has been authentically confirmed by many observers. Healthy organs may be acutely inflamed and those previously diseased may be greatly aggravated by the passage of such an irritant over their secretory surfaces. The danger to the kidneys led to the general adoption of the method by forced etherization, by which the asphyxia lessens the quantity of the ether required.

Ether more frequently than chloroform causes nausea and vomiting. This is an important consideration in the selection of an anæsthetic to be administered in cases in which persistent retching may interfere with the healing of important wounds.

While the immediate dangers of ether are comparatively slight, those which occur subsequently, to which we have just alluded, are matters of very serious consequence. These dangers weigh heavily against the merits of this anæsthetic.

Now, let us pass in running review the advantages and dangers of chloroform.

Its non-inflammability in the presence of artificial light, or the actual cauteries, is an advantage which increases greatly the range of its usefulness. It is certainly the more agreeable to patients, less irritating to the sensory nerves of the respiratory passages and the more enduring in its anæsthetic effect. It causes comparatively little increase of mucous secretion. It is easier of administration, and the mode of administration does not entail any other effect than that of a pure and simple anæsthetic. Chloroform is the more energetic agent, possessing the inherent toxical quality in higher degree than ether. This quality, however, does not differ in character from that which ether possesses.

The primary effect of chloroform, as of ether, is stimulating to the cerebrum and the vital functions; but the excitement is less intense and of shorter duration than in etherization. Being the more energetic agent, it requires less saturation of the system for the exercise of its anæsthetic power. This is an important consideration. The practical advantages of chloroform in surgery are very striking. These and its comparative freedom from disastrous sequelæ take away much of the terror of its immediate dangers.

The dangers of chloroform are soon told. They are immediate. If patients do not die during the administration they are comparatively safe. Nearly 50% of deaths by chloroform occur at the outset of the administration. The chief danger of chloroform is paralysis of the nervous apparatus governing circulation and respiration mentioned in the order of frequency. The centres are taken by surprise by the direct and energetic action of chloroform and overwhelmed quickly. This sudden action has given to chloroform the name of being treacherous. It teaches unmistakably the necessity of gradually accustoming the centres to the influence of anæsthetics. We dwell on this point with special emphasis.

A large proportion of deaths by chloroform are reported as occurring suddenly and without warning. These cases are usually reported in a way to lay all the blame on chloroform. While we do not doubt the extreme susceptibility of some patients, which makes them liable to such fatal accidents, we are constrained to believe that in more instances than recorded there are timely admonitions of danger. These admonitions are irregularities of the heart's action and respiration. Experiments on animals have shown how, under chloroform anæsthesia, the heart is liable to sudden irregularities. Clinical experience confirms the observation. Irregularity of the heart's action, as regards the strength of its beats, is especially ominous. The hesitating, irregular respiration of chloroform anæsthesia is but little less valuable as a warning of danger, and certainly demands more attention than usually given. The statistics before mentioned show that in one-fourth of forty cases of chloroform death respiration failed before the heart's action. Patients who breathe irregularly should be anæsthetized with the utmost caution. These irregularities of the heart's action and respiration indicate a condition of the centres which bears anæsthetics badly. This condition is more frequently observed in the anæmic and weakly, and in those under the influence of depressing emotions.

The dangers of ether and of chloroform are modified by methods of administration. Indeed, we feel safe in venturing the assertion that the dangers of anæsthesia lie not more in the inherent property of the agent employed than in the manner of its administration.

The risks are very much greater in the unskilful administration of chloroform than in reckless etherization. In view of the danger of its primary effect, we insist here on the advisability of preparing the way for chloroform. Agents should be given in advance to stimulate the vital reflexes and prepare the nerve centres for the coming anæsthetic effect.

The old-fashioned whisky toddy, taken just before the anæsthetic, still has its votaries. The use of alcohol in this way is objectionable. We cannot rely on absorption from the stomach at the very time its stimulating action is most desirable. If given immediately before the anæsthetic, it is not absorbed in time to sustain the centres as they undergo primary anæsthesia. If given in time for absorption, the alcohol antagonizes the action of the anæsthetic. Alcoholic patients are difficult to anæsthetize, and while under anæsthesia, they often show alarming symptoms.

Again, alcohol is uncertain in the physiological action for which it is given. In many subjects, by abuse, perhaps it may have long since lost its medicinal virtue, while in others its effect may be variable because of nervous susceptibility. Alcohol taken into the stomach before anæsthesia has the effect of exciting many patients after a surgical operation, at the time when it is most desirable that they should be calm. This excitement may increase the liability to inflammation. The maximum good, with the least harm, follows the use of alcohol when administered hypodermatically, or by inhalation at the outset of anæsthesia. The first whiffs of chloroform may well be mixed with the vapor of alcohol.

A few breaths of the vapor of ammonia, in advance of chloroform, act like alcohol, but more potently and. without its disagreeable effects.

The method of mixed anæsthesia, by the hypodermatic administration of the sulphate of morphia alone, or in combination with a respiratory stimulant, as the sulphate of atropia, is as sound in physiological principle as useful in practice. The doses of the sulphate of morphia in adults should not exceed one-twelfth to one-sixth of a grain; of the sulphate of atropia, one two-hundredth to one one-hundred and fiftieth of a grain. The atropine acts particularly well in states of bronchial catarrh, in pulmonary diseases and in all cases indicating the action of a respiratory stimulant. The hypodermatic use ot morphine, in the doses recommended, secures the primary stimulant effect promptly when desired, aids the anæsthetic in its action, and subsequently promotes the relief necessary after surgical procedures.

A safe way of preparing the centres for chloroform, and one which we strongly recommend, is by stimulating them primarily with the inhalation of ether. The centres more easily adjust themselves to the action of ether. Statistics show that the danger of the first effect of ether is almost infinitesimal. Thus, the anæsthesia is begun with the agent safer at the beginning, and continued with the agent less harmful in its subsequent effects.

There are causes of danger in the administration of chloroform which occur so commonly as to warrant special mention here. Chief among these common causes of fatal accidents is overdosage—an excessive amount in a given time. Patients being anæsthetized with chloroform should never experience the sense of suffocation of which we too frequently hear them complain. Coughing early in the anæsthesia is usually an evidence of over-action. Chloroform anæsthesia should be begun with minimum doses—a few drops only—and continued to the degree desired in quantities gradually increasing. To overdosage more than to idiosyncrasy of patients should be attributed most of the accidents by chloroform. Witness the manner in which so many physicians give chloroform, by saturing the inhaler at the outset and forcing the anæsthesia, and there will be less difficulty in explaining many of those deaths that occur with such electric suddenness.

Haste in the administration of chloroform deserves most emphatic condemnation. The anæsthesia should be produced gradually and maintained uniformly. We believe it unsafe to advise patients at the beginning to "take long breaths" with the view of quickly inflating the lungs with saturated air, in order to produce a rapid effect.

In the calm which follows the preliminary excitement chloroform acts with increased energy. The centres are at this moment in a state of exhaustion, and not prepared to have the anæsthesia forced. The depression which follows the primary excitement is a period in which much harm may be done by overdoses of chloroform.

Instead of forcing chloroform anæsthesia, at any time, during its administration, it is better now and then to give the patient a rest spell, in order to refresh the residual air of the lungs. Some of the singularly sudden deaths, of which we read, may be accounted for by the cumulative effect on the centres caused by the sudden absorption of vapor which saturates the residual air.

Statistics are yet wanting by which we can accurately estimate the relative death-rate caused by ether and chloroform. At the meeting of the New York Academy of Medicine, elsewhere mentioned, Dr. Weir reported five deaths by ether in 10,789 surgical operations. One surgeon reported two deaths by ether, occurring in his own practice, in the course of as many months. These figures do not, most probably, include deaths caused by etherization, yet occurring subsequently, which in years past were not so well understood as now. However, the proceedings of the Academy prove very convincingly the dangers of an agent which enjoys an undeserved reputation for its safety.

At the same meeting of the Academy Dr. Knapp, of New York, reported that from 1860 to 1876 he had used chloroform in three thousand cases without a death; that since 1870 he had used ether exclusively, also without a death. The last death of chloroform in our Charity Hospital occurred on the 12th of November, 1881; the subject a tertiary syphilitic with albuminuria, undergoing operation for removal of necrosis of the tibia. This was one of those appalling sudden deaths, most of which occur in patients who are anæmic and wasted by chronic illness. The hospital records do not show the number of cases in which general anæsthetics have been used since 1881, but give the quantity of ether and chloroform consumed, all of which, save the small quantity used for other purposes, was given as a general anæsthetic. In 1881 eighty-eight pounds of chloroform were used, six of ether; in 1882, one hundred and five of chloroform, two of ether; in 1883, one hundred and two and eighteen; in 1884, ninety-four and fourteen; in 1885, one hundred and sixteen and twenty-three; in 1886, eighty-eight and fifty-six; from January 1 to June 1, 1887, fifty-three pounds of chloroform and eighteen of ether. During the five years, 1882 to 1886, inclusive, five hundred and fifteen pounds, or nearly fifty gallons of chloroform, and one hundred and thirteen pounds, or a little more than seventeen gallons of ether, were used in the hospital. During these years 85,680 patients of all diseases have been treated, and, as will appear in the figures showing the relative quantity of ether and chloroform used, the vast majority of the patients requiring general anæsthesia, including seven hundred cases of important surgical operations reported, have been treated with chloroform. The above statements are made simply to convey an approximate idea of the extent to which chloroform has been used in this house since 1881 without fatal accident.[1]

It is our conviction, with the lights before us, that chloroform, carefully administered, with the precautions herein indicated, is as safe as ether administered by the plan generally practiced in America at the present day. However, the unskilful administration of chloroform and inattention to its warnings are fraught with so much more danger than attends or follows etherization by the usual method, that we recommend ether in the surgery of adults whenever its use is not contraindicated.

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[1] During the civil war Dr. Hunter McGuire collected the reports of 28,000 administrations of chloroform without a death. Nussbaum has recorded 40,000 cases of chloroform anæsthesia without a death. These records are very remarkable.

Let us now apply practically what we have written, and in conclusion, sum up those conditions indicating and contraindicating the use of ether and of chloroform.

As a rule, in the surgery of adults, anæsthesia should be begun with ether, and continued with ether, unless contraindicated. The chief contraindications are pre-existing inflammation of the respiratory passages, of the lungs or the kidneys; insusceptibility to the effect of ether, unless given in overdoses; violent excitement, which may endanger the cerebral vessels in the infirm; and local evidences of excessive irritation of the respiratory surfaces.

In all quick operations which can be performed during primary anæsthesia, ether is especially preferable. The danger of its primary effect is insignificant.

Ether is the more applicable in all states of anæmia, acute and chronic; and in states of extreme nervous depression, whether caused by shock, fright or the neurasthenia of chronic disease. These are the conditions in which chloroform deaths have occured most frequently.

Ether is especially preferable in cardiac diseases and degenerations, where the organ is weak in its action, particularly in those cases in which the heart's feebleness is manifested in irregularity as to the strength of its beats. Such are the hearts that are exhausted by overwork; the dilated hearts of mitral and aortic regurgitation; the hearts which sympathize in states of general ill-health, poorly-nourished, relaxed in tissue, unsteady in action; the hearts of those convalescing of chronic diseases, of patients depleted by exhausting discharges or hemorrhages, of chronic alcoholics, of old syphilitics; and the hearts which have undergone degenerative changes, resulting from disease, or the decay which comes with age.

Chloroform is permissible in cardiac diseases, attended with over-action of the organ, as in states of compensatory hypertrophy. It is indicated in this condition of the organ, when associated with nephritis. In all diseases and deformities of the heart, whatever murmurs may be heard, if the organ functions well, chloroform may be given if indicated. As there are a great many crippled limbs doing good service, so there are many hearts, altered by past diseases, which yet act so well as to give no trouble. Such hearts are apt to beat more steadily under an anæsthetic than when submitted to the tortures of a painful surgical procedure without it.

Chloroform is preferable whenever a general anæsthetic is required in cases suffering of pulmonary diseases. It is less irritating to the respiratory surfaces, causes but little increase of the mucous secretion, and interferes less with the pulmonary circulation. The contraindication to ether in these cases is very positive.

In nephritis chloroform is the preferable anæsthetic. In the chronic stage ether is only permissible at the beginning of anæsthesia, to sustain the heart, now usually very weak, and prepare the nerve centres for chloroform. Of all the conditions said to contraindicate both of these general anæsthetics, Bright's diseases are entitled to the most serious consideration. Aside from the asthenic state of heart muscle, respiration is very often impaired, either by pulmonary œdema, or the renal asthma, which results from anæmia of the nerve centres. These conditions in the aggregate make the use of any anæsthetic of maximum danger. The observation of the harmful effect on the kidneys, by blood charged with ether, has been authentically confirmed by a number of writers, and has contributed greatly to a better appreciation of the dangers of ether.

Cases are occasionally met in which ether fails to produce surgical anæsthesia, unless given in an amount to saturate the system to a dangerous degree. Such patients, in our observation, after the preparation of the nervous system by ether, take chloroform very happily and go quickly under its influence.

Chloroform is preferable, then, in all cases that take ether badly, and those in which the anæsthetic power of ether is insufficient unless administered in overdoses.

Chloroform is the preferable anæsthetic in childhood. Statistics show that children, compared with adults, enjoy exceptional immunity from accidents by chloroform. Children bear chloroform so well that many can be anæsthetized during sleep; while, under ether, they struggle and strangle and pass through an agony of indescribable terror.

Shall we use ether or chloroform in the aged and infirm? Here we are dealing with organs as delicate as fragile glassware. The heart is tottering in its action, and the brain is fed by vessels too brittle for any overstrain. Shall we select the milder anæsthetic, the safer for the heart, but which usually excites such violent struggling and such tumult in the circulation as to endanger the cerebral vessels by rupture, and which causes subsequent dangers so serious in infirm people? Or shall we select chloroform, which obviates all the objections to ether, but which unquestionably, in these subjects, acts on the cardiac and respiratory nervous apparatus with increased energy? The condition of the organs endangered in individual cases should decide the choice. In infirm subjects, more especially, anæsthesia should be begun with ether, when not contraindicated, and so continued in those who take it well. If there be much struggling and resistance, or much increased bronchial secretion, or other evidences of the injurious action of ether, then chloroform should be substituted. In our experience, after the first effect of ether, chloroform has proved the preferable agent in most cases of aged and infirm subjects, save those whose hearts are very weak and irregular.

Shall we use ether or chloroform in cases which may be seriously complicated by nausea and vomiting, as in abdominal and gynecological surgery, and the surgery of the cerebrum? The danger of suffocation by vomited matter, especially in etherization, should never be lightly regarded, nor the ill-effects of persistent nausea and retching on the healing of important wounds. Chloroform less frequently than ether causes vomiting, and in emergencies requiring general anæsthesia before the digestion of a meal, is the preferable agent. Indeed, in all cases where obstinate retching after surgical operation might endanger life, chloroform is preferable.

As a measure to prevent nausea and vomiting under anæsthesia we wish to lay stress on the importance of administering the anæsthetic gradually and maintaining the anæsthesia in a uniform degree. Any surprise to the centres, or sudden alteration of their molecular or nutritive changes, may cause nausea. An hypodermatic injection of the sulphate of morphia occasionally has this effect. So, anæsthetics, or other agents acting similarly, when administered interruptedly, act unevenly on the centres, and by such repeated surprises cause nausea. They act like a rough sea.

Chloroform and ether, therefore, have their respective fields of usefulness, in which they are equally serviceable. They are equally dangerous when given in the face of their contraindications. Not until medical men learn to discriminate properly in their choice of these anæsthetics, and recognize the fact that the dangers of general anæsthesia depend as much on the method of administration as on the toxical property of the agent employed, will the risk of fatal accidents ever be reduced to the minimum."

ON THE SUTURE OF NERVES.

An elaborate article on the subject of the "Suture of Nerves" appears from the pen of Dr. Reclus, Agregé de la Faculté de Paris, in *Le Bulletin Medicale*, June 5, 1887, in which the subject is discussed from a physiological standpoint. As the subject is one of the living topics of the day a very full abstract of this paper is subjoined. In connection with this paper, the student will do well to refer to the editorial notices of many recent contributions to this subject to be found in the ANNALS OF SURGERY, Vol. I, p. 132, 1885, and to the paper by Markoe, in Vol. II, p. 181, 1885.

Reclus begins by calling attention to the great obscurity which still hovers over the anatomical and functional changes which a nerve undergoes after section, suture and union. In spite of twenty years of patient observations and researches, experimental physiology and practical surgery have not been able to come in accord. If we are